

## CLAIMS

1. A method, comprising:

receiving a reset exchange identification (XID) command at a Logical Link

5 Control (LLC) of a mobile station (MS);

resetting all LLC XID parameters to their default values;

discarding all requests that are pending from a layer-3 communication layer to a plurality of logical link entities (LLEs);

receiving a logical link reset indication (LL-RESET-indication) from the LLC at a

10 Sub-Network Dependent Convergence Protocol (SNDCCP) layer; and

upon receipt of the LL-RESET-indication, the performing the following acts at the SNDCCP:

resetting all SNDCCP XID parameters to their default values;

for every network service access point identifier (NSAPI) using

15 unacknowledged peer-to-peer LLC operation, setting a sequence number of the next network packet data unit (N-PDU) to be sent by the SNDCCP to zero;

if the NSAPI is using unacknowledged peer-to-peer LLC operation, then:

transmitting outstanding SNDCCP-to-LLC requests to the LLC.

20 2. The method of claim 1, comprising the further acts of:

before receiving the XID command:

performing a GSM task;  
suspending GPRS service; and  
buffering the one or more SNDCP-to-LLC requests in the LLC.

5           3.     The method of claim 2, comprising the further acts of:  
  
              performing a routing area network update, thereby resulting in the reset XID  
command being received by the LLC after the buffering by the LLC of the one or more  
SNDCP-to-LLC requests.

10           4.     The method of claim 2, wherein the act of performing a GSM task  
comprises performing a MS location area update, the method further comprising the act  
of:  
  
              performing a GPRS task by the MS after suspending the GPRS service.

15           5.     The method of claim 2, wherein the GPRS task comprises sending an  
electronic mail (e-mail) message.

              6.     The method of claim 1, wherein the SNDCP-to-LLC requests include  
logical link unit data requests.

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7. The method of claim 1, wherein the SNDCP-to-LLC requests comprise logical link XID requests.

8. A method to provide reliable communications between a mobile station  
5 (MS) and a wireless communication network after a layer-2 component of the MS is reset, the method comprising the acts of:

sending one or more requests having an unconfirmed transmission status from a layer-3 component of the MS to the layer-2 component; and

sending the one or more requests over an unacknowledged logical link from the  
10 MS to the wireless communication network.

9. The method of claim 8, comprising the further act of:

acknowledging the layer-3 component that the one or more requests have been transmitted.

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10. The method of claim 8, wherein the layer-2 component comprises a Sub-Network Dependent Convergence Protocol (SNDCP) and the layer-3 component comprises a Logical Link Control (LLC) layer.

11. In a mobile station (MS), a method to prevent discarding one or more requests that are pending from layer-3 to a Logical Link Control (LLC) layer, the method comprising the acts of:

flushing a first instance of one or more pending packet data units (PDUs) from a

5 PDU transmit queue associated with the LLC layer;

receiving a second instance of the one or more pending PDUs from the layer-3;

and

sending the second instance of the one or more pending PDUs from the MS via an unacknowledged logical link.

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12. A method of resetting Sub-Network Dependent Convergence Protocol (SNDCCP) reset exchange identification (XID) parameters, initializing SNDCCP unacknowledged Network Service Access Point Identifier (NSAPI) network packet data unit (N-PDU) numbers, and recovering outstanding unacknowledged NSAPI requests, comprising the acts of:

receiving, from a Logical Link Control (LLC) layer, a logical link reset indication (LL-RESET-indication) at the SNDCCP;

upon receipt of the LL-RESET-indication, the performing the following acts at the SNDCCP:

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resetting all SNDCCP XID parameters to their default values;

for every network service access point identifier (NSAPI) using unacknowledged peer-to-peer LLC operation, setting a sequence number of the next N-PDU to be sent by the SNDTCP to zero; and

if the NSAPI is using unacknowledged peer-to-peer LLC operation:  
5 transmitting outstanding SNDTCP-to-LLC requests to the LLC.

13. A system for unacknowledged Network Layer Service Access Point Identifier (NSAPI) recovery in Sub-Network Dependent Convergence Protocol (SNDTCP) communication, comprising:

10 a recovering SNDTCP module having:

a protocol interface which receives packet data units (PDUs) and multiplexes unacknowledged NSAPI communications into requests;

means for outstanding request tracking to determine the status of the requests;

15 request resending means for selectively resending outstanding requests upon reception of a layer-2 reset indication;

a layer-2 interface for transmitting the requests and for receiving the layer-2 reset indication;

a Logical Link Control (LLC) module connected to the layer-2 interface and  
20 having:

a queue for queuing the requests received from the recovering SNDCP module, the requests including the PDU transmit requests;

means for acknowledging the recovering SNDCP upon completion of the requests;

5 means for indicating the layer-2 reset indication to the recovering SNDCP;

a layer-1 module connected to the LLC module via the layer-1 interface for transmitting the PDUs from a first component of the system to a second component of the system over a physical layer.

10 14. A system for unacknowledged layer-2 recovery in layer-3 communication, comprising:

a recovering layer-3 module having:

a protocol interface for receiving data and multiplexing the data into requests;

15 means for outstanding request tracking to determine the status of the requests;

request resending means for selectively resending outstanding requests upon reception of a layer-2 reset indication;

20 a layer-2 interface for transmitting the requests and for receiving the layer-2 reset indication;

a layer-2 module connected to the layer-2 interface of the recovering layer-3 module, the layer-2 module having:

a queue for queuing the requests received from the layer-3 module;

the requests including the data;

5 means for acknowledging to the recovering layer-3 module upon completion of the requests;

means for indicating a reset condition to the recovering layer-3 module via the layer-2 reset indication of the layer-2 interface;

a layer-1 interface for transmitting the data to a layer-1 module;

10 a layer-1 module connected to the layer-2 module via the layer-1 interface for transmitting the data from a first component of the system to a second component of the system over a physical layer.

15 15. The system of claim 14, wherein the recovering layer-3 module comprises a Sub-Network Dependent Convergence Protocol (SNDCCP) module for General Packet Radio Service (GPRS).

16. A system of claim 14, wherein the layer-2 module comprises a Logical Link Control (LLC) module for General Packet Radio Service (GPRS).

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17. The system of claim 14, wherein the layer-1 module comprises a Global System for Mobile (GSM) sub-layer.

18. The system of claim 14, wherein the layer-1 module comprises a Universal  
5 Mobile Telecommunications System (UMTS) sub-layer.

19. A method of layer-2 recovery comprising the acts of:  
identifying a layer-2 reset condition in layer-3;  
after identifying the layer-2 reset condition, identifying outstanding layer-3 to  
10 layer-2 requests for unacknowledged layer-2 communication; and  
resending outstanding layer-3 to layer-2 requests from layer-3 to layer-2.

20. The method of claim 19, comprising the further acts of:  
upon identifying the reset condition in layer-3:  
15 setting unacknowledged layer-2 communication sequence numbers to  
zero in layer-3; and  
entering a recovery state in layer-3 for acknowledged layer-2  
communications.

20 21. A protocol stack for a mobile station (MS) comprising:



a recovering layer which receives data and sends the data as requests, the recovery layer including:

a tracking module which tracks outstanding requests that have not received acknowledgements from a lower transmitting layer;

5 a resend module which resends the outstanding requests upon receiving a reset indicator from the transmitting layer; and

a transmitting layer which receives requests from the recovering layer, sends acknowledgements to the recovering layer corresponding to requests that have been sent, and signals the reset indicator to the recovery layer upon occurrence of a reset at  
10 the transmitting layer.

22. A mobile station, comprising:

a receiver;

a transmitter;

15 an antenna coupled to the receiver and the transmitter;

one or more processors including:

a layer-2 module which interfaces with the receiver and the transmitter;

a layer-3 module which interfaces with the layer-2 module;

the layer-3 module being operative to facilitate data communication for  
20 the mobile station by sending a plurality of requests to a queue of the layer-2

module, each request being a type that is acknowledged by the layer-2 module but unacknowledged by a destination node; and

the layer-3 module being further operative to resend one or more requests that are unacknowledged by the layer-2 module in response to a reset indication.

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23. The mobile station of claim 22, wherein the requests comprise unacknowledged Network Layer Service Access Point Identifier (NSAPI) requests.

24. The mobile station of claim 22, further comprising:

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the layer-2 module comprising a Logical Link Control (LLC) layer; and

the layer-3 module comprising a recovering Sub-Network Dependent Convergence Protocol (SND CP) layer.

25. The mobile station of claim 22, further comprising:

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the layer-3 module being further operative to set, in response to the reset indication at the layer-3 module, a packet data unit (PDU) number to zero for use in resending the one or more requests.

26. A method of communicating data comprising:

facilitating data communication by sending a plurality of requests from a layer-3 module to a queue of a layer-2 module, each request being a type that is acknowledged by the layer-2 module but unacknowledged by a destination node; and

in response to a reset indication, resending one or more requests that are  
5 unacknowledged by the layer-2 module.

27. The method of claim 26, wherein the requests comprise unacknowledged Network Layer Service Access Point Identifier (NSAPI) requests.

10 28. The method of claim 26, wherein the layer-2 module comprises a Logical Link Control (LLC) layer and the layer-3 module comprises a recovering Sub-Network Dependent Convergence Protocol (SNDCCP) layer.

29. The method of claim 26, further comprising the act of:  
15 in response to the reset indication at the layer-3 module, setting a packet data unit (PDU) number to zero for use in resending the one or more requests.

30. A method of communicating data in a mobile station, comprising the acts  
of:

facilitating a data communication by sending a plurality of requests from a layer-3 module to a queue of a layer-2 module, each request being a type that is acknowledged by the layer-2 module but unacknowledged by a destination node;

receiving a reset at the layer-2 module before the data communication is fully completed;

attempting to continue at least a portion of the data communication by sending one or more additional requests from the layer-3 module to the queue of the layer-2 module;

flushing a queue of the layer-2 module in response to the reset;

receiving a reset indication at the layer-3 module; and

in response to the reset indication, resending, from the layer-3 module to the layer-2 module, the one or more additional requests which have been unacknowledged by the layer-2 module.

31. The method of claim 30, further comprising:

sending, from the layer-2 module to the destination node, the one or more additional requests resent by the layer-3 module.

32. The method of claim 30, wherein the requests comprise unacknowledged Network Layer Service Access Point Identifier (NSAPI) requests.

33. The method of claim 30, wherein the layer-2 modules a Logical Link Control (LLC) layer and the layer-3 module comprises a recovering Sub-Network Dependent Convergence Protocol (SNDCCP) layer.

5 34. A mobile station, comprising:

a receiver;

a transmitter;

an antenna coupled to the receiver and the transmitter;

one or more processors including:

10 a layer-2 module which interfaces with the receiver and the transmitter;

a layer-3 module which interfaces with the layer-2 module;

the layer-3 module being operative to facilitate a data communication for the mobile station by sending a plurality of requests to a queue of the layer-2 module, each request being a type that is acknowledged from the layer-2 module but unacknowledged from a destination node;

15 the layer-2 module being operative to receive a reset at the layer-2 module before the data communication is fully completed;

the layer-3 module being operative to continue attempting at least a portion of the data communication by sending one or more additional requests to the layer-2 module;

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the layer-2 module being operative to flush the queue in response to the reset;

the layer-3 module being operative to receive a reset indication at the layer-3 module; and

5           the layer-3 module being operative to resend the one or more additional requests to the layer-2 module which have been unacknowledged by the layer-2 module.

35.   The mobile station of claim 34, further comprising:

10           the layer-2 module being further operative to send the one or more additional requests resent from the layer-3 module to the destination node.

36.   The mobile station of claim 34, wherein the requests comprise unacknowledged Network Layer Service Access Point Identifier (NSAPI) requests.

15           37.   The mobile station of claim 34, wherein the layer-2 modules a Logical Link Control (LLC) layer and the layer-3 module comprises a recovering Sub-Network Dependent Convergence Protocol (SNDCCP) layer.

20           38.   A method of communicating data in a mobile station comprising the acts of:

operating in a General Packet Radio Service (GPRS) mode;

facilitating a data communication in the GPRS mode which includes:

    sending a plurality of requests from a layer-3 module to a queue of a  
layer-2 module, each request being a type that is acknowledged from the layer-2  
5 module but unacknowledged from a Serving GPRS support node (SGSN);

    sending the requests from the queue of the layer-2 module to the SGSN;

    switching operation from the GPRS mode to a Global Systems for Mobile (GSM)  
mode before the data communication is fully completed;

    attempting to continue at least a portion of the data communication by sending  
10 one or more additional requests from the layer-3 module to the layer-2 module;

    receiving a reset at the layer-2 module due to the switching from the GPRS  
mode;

    flushing the queue of the layer-2 module in response to the reset;

    receiving a reset indication at the layer-3 module;

15 resending, by the layer-3 module to the layer-2 module, the one or more  
additional requests which have been unacknowledged by the layer-2 module;

    switching operation back to the GPRS mode from the GSM mode; and

    completing the data communication in the GPRS mode by sending, from the  
layer-2 module to the SGSN, the one or more requests resent by the layer-3 module.

39. The method of claim 38, wherein the requests comprise unacknowledged Network Layer Service Access Point Identifier (NSAPI) requests.

40. The method of claim 38, wherein the layer-2 modules a Logical Link  
5 Control (LLC) layer and the layer-3 module comprises a recovering Sub-Network  
Dependent Convergence Protocol (SNDCCP) layer.